



Section 1. Choose the correct answer:

1. The number of multiplications in convolution of a $W \times W$ separable filter (you can get the square filter by convolution a single column vector by some row vector) with an $N \times N$ image can be reduced to

- (a) $2WN$
- (b) $2WN^2$
- (c) W^2N^2
- (d) $2W^2N^2$

2. A place of rapid change in the image intensity function is

- (a) An object center.
- (b) An edge.
- (c) A derivative.
- (d) A gradient.

3. The transformation used to correct the skewed image like this



- (a) Perspective Transformation
- (b) Hough Transformation
- (c) Affine Transformation
- (d) **a and c**

4. Hough transform polar representation

- (a) overcomes the problem of representing vertical lines.
- (b) takes a parameter the perpendicular distance from line to origin.
- (c) takes a parameter the angle the perpendicular makes with the x-axis.
- (d) All of the above.
- (e) **b and c only.**

5. Current vision systems can do

- (a) 3D Modeling and Medical Imaging.
- (b) Optical Character Recognition (OCR).
- (c) Face or Smile detection.
- (d) All of the above.

6. A common example of 2D interpolation is image

- (a) enhancement
- (b) sharpening
- (c) blurring
- (d) resizing

7. Sampling is a common technique used when digitally represent continuous signals, undersampling problems include
- (a) information loss.
 - (b) indistinguishable from lower frequency.
 - (c) indistinguishable from higher frequency.
 - (d) signals “traveling in disguise” as other frequencies (aliasing).
 - (e) All of the above.
8. A circle with unknown radius in the image corresponds in Hough space to
- (a) A point.
 - (b) A line.
 - (c) A circle.
 - (d) A cone.
9. A single 2D edge detection filter
- (a) Gaussian.
 - (b) derivative of Gaussian.
 - (c) Laplacian of Gaussian.
 - (d) Fourier.
10. To prevent aliasing, low pass filters are used to
- (a) remove input high frequencies leaving only safe, low frequencies.
 - (b) remove high frequencies in reconstruction, choose lowest frequency (disambiguate).
 - (c) **a** and **b**.
 - (d) **a** but not **b**.
11. A line in the image corresponds in Hough space to
- (a) A point.
 - (b) A line.
 - (c) A circle.
 - (d) A cone.
12. Convolution is to
- (a) Flip where the filter is applied in both dimensions (bottom to top, right to left).
 - (b) Apply cross-correlation.
 - (c) Use uniform weights walking average.
 - (d) **a** then **b**
13. What parameters increase the smoothness of a Gaussian filter?
- (a) Larger kernel size.
 - (b) Smaller variance (Smaller σ).
 - (c) Larger variance (Larger σ).
 - (d) **a** and **c**.

14. The effect of applying the following filter to an image is $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 0 \end{bmatrix} - 1/9 \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

- (a) Blurring
- (b) Sharpening
- (c) Salt and pepper
- (d) Impulse

15. A system H is linear if

- (a) $H(f_1 + f_2) = H(f_1) + H(f_2)$ (it is additive).
- (b) $H(a.f_1) = a.H(f_1)$ (it is scale multiplicative).
- (c) **a** but not **b**
- (d) **a** and **b**

16. Hough transform is a technique for

- (a) Line fitting.
- (b) Edge detection.
- (c) Blurry filtering.
- (d) Removing noise.

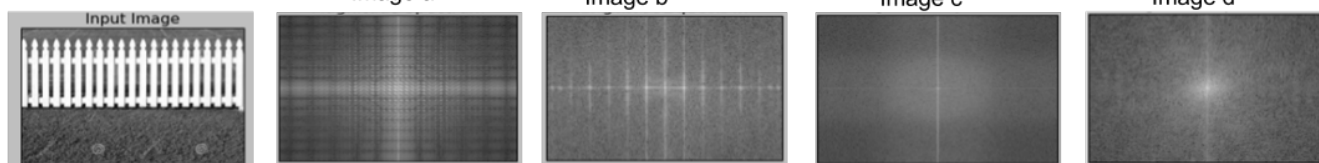
17. Convolution in spatial domain equals in frequency domain

- (a) Addition
- (b) Correlation
- (c) Multiplication
- (d) differentiation

18. The gradient direction that is given by $\theta = \tan^{-1}(\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x})$ is

- (a) parallel to the edge direction.
- (b) orthogonal to the edge direction.
- (c) not relative to the edge direction.
- (d) orthogonal to the image plan.

19. A magnitude spectrum of Fourier transform for the input image in the figure below is



- (a) Image a
- (b) Image b
- (c) Image c
- (d) Image d

20. After applying the second derivative of Gaussian to a single row or column of the image, an edge is at

- (a) the local maximum.
- (b) the zero crossing.
- (c) the global minimum.
- (d) the global maximum.

21. All of the following are well-known masks for computing gradients **EXCEPT**
- (a) Sobel
 - (b) Fourier
 - (c) Prewitt
 - (d) Roberts
22. Properties of convolution are
- (a) linear and shift invariant.
 - (b) commutative ($f * g = g * f$) and associative ($((f * g) * h = f * (g * h))$).
 - (c) Identity ($f * e = f$) if unit impulse $e = [..., 0, 0, 1, 0, 0, ...]$.
 - (d) $\frac{\partial}{\partial x}(f * g) = \frac{\partial f}{\partial x} * g$
 - (e) All of the above.
23. Suppose we have a NxM RGB image called “im”, the bottom-right pixel in Green-Channel is
- (a) `im[1, 1, 2]`
 - (b) `im[M, N, 1]`
 - (c) `im[N, M, 1]`
 - (d) `im[1, 1, 1]`
24. A median filter
- (a) Is edge preserving.
 - (b) Removes spikes.
 - (c) Is good for impulse, salt and pepper noise.
 - (d) All of the above.
25. The gradient magnitude which is denoted by $\|\nabla f\| = \sqrt{(\frac{\partial f}{\partial x})^2 + (\frac{\partial f}{\partial y})^2}$ gives
- (a) the edge strength.
 - (b) the edge direction.
 - (c) the edge length.
 - (d) All of the above.

Section 2. True or False.

1. ____ Salt and pepper noise is random occurrences of gray pixels.
2. ____ It is easy to detect an edge from a noisy image using only the derivative.
3. ____ The line that contains two points in the image space corresponds to the intersection of the two lines that represent these points in Hough space.
4. ____ Noise is a function that is combined with the original function (image) to get a new function (noisy image).
5. ____ Canny edge detector defines two thresholds: low and high.
6. ____ When projecting light from 3D points to a film, make the aperture as small as possible.
7. ____ Filtering (slide the kernel) an impulse signal results in a reversed response.
8. ____ Fat Gaussian in space is skinny Gaussian in frequency.
9. ____ To maintain a smooth image when subsampling for size reduction, filter with Gaussian first.
10. ____ We get the projection by throwing out the last (Z) coordinate.

Answer Key for Exam A

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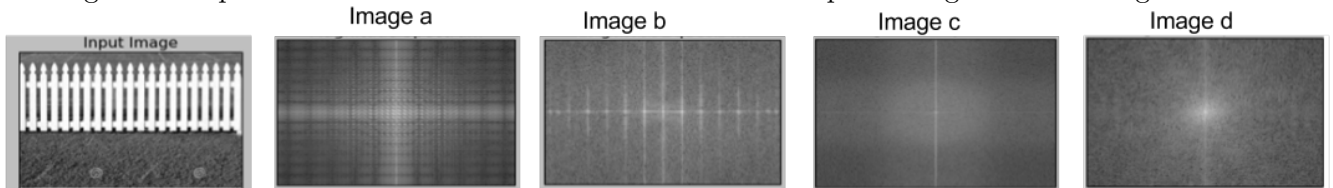
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Section 2. True or False.

1. False Salt and pepper noise is random occurrences of gray pixels.
2. False It is easy to detect an edge from a noisy image using only the derivative.
3. True The line that contains two points in the image space corresponds to the intersection of the two lines that represent these points in Hough space.
4. True Noise is a function that is combined with the original function (image) to get a new function (noisy image).
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